Space Weather Technical Forecast

Issued on Wednesday, 30 November 2022 at 13:20 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: G1/Minor Geomagnetic Storm intervals likely initially, reducing later. Active electron fluence expected day 1 (30th), reducing until day 4 then becoming likely again by day 4.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with several low levels C-class flares, and one long duration C4.2, which appeared from AR3151 as it rotated off the western limb. There are currently three sunspot regions on the visible disc. AR3152, in the northwestern hemisphere, and two small and simple NEW regions are also present. One follows shortly behind the aforementioned numbered region, and the other in the southeast heading toward the central meridian, all active regions are small and simple.

No new Earth-directed CMEs have been observed in available imagery, though we await computation of 3 CME's ejected from the Sun late on 29th.

Solar Wind / Geomagnetic Activity: Solar wind parameters, as measured by ACE and DSCOVR at L1, were indicative of positive coronal hole High Speed Stream influences. Solar wind speeds have been either Elevated or Strong, fluctuating between 560-650 km/s due to CH49/+. Density was around average or slightly above. The IMF, Bt, rose from weak to moderate, ending at 9nT. The north south component ranged from +7/-8 nT but with no sustained negative periods. The phi angle was predominantly positive (away from the Sun). Geomagnetic activity was mostly Quiet to Active (Kp 2-4).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) as measured at GOES16 has remained at Background levels. High energy electron flux (greater than 2MeV) at GOES16 was at mostly high levels, peaking at 2.62e3 at 30/1130 UTC. Observed fluence at 30/0001 UTC was 5.35e7 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to remain Low over the forecast period, with a isolated C-class flares considered likely, with a very slight chance of isolated M-flares.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are expected during the period, though several CME's are currently being computed. Solar winds are currently strong due to the connection with CH49/+. The next solar wind enhancement is expected either late on day 1 (30th Nov) or early on day 2 (1st Dec) due to the arrival of the high speed stream from CH51/+, with speeds up to 600-700 km/s. Solar wind speeds then falling back to slightly elevated or background by the end of day 4 (3rd).

Geomagnetic activity is expected to be Unsettled to Active with likely isolated G1/Minor storm intervals due to the onset of CH51/+ during either day 1 or day 2 (30th or 1st), with a slight chance of G2/Moderate storms. The chance for G1/Minor storming intervals then reduces into day 3 and beyond due to the waning effects of CH51/+.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) at

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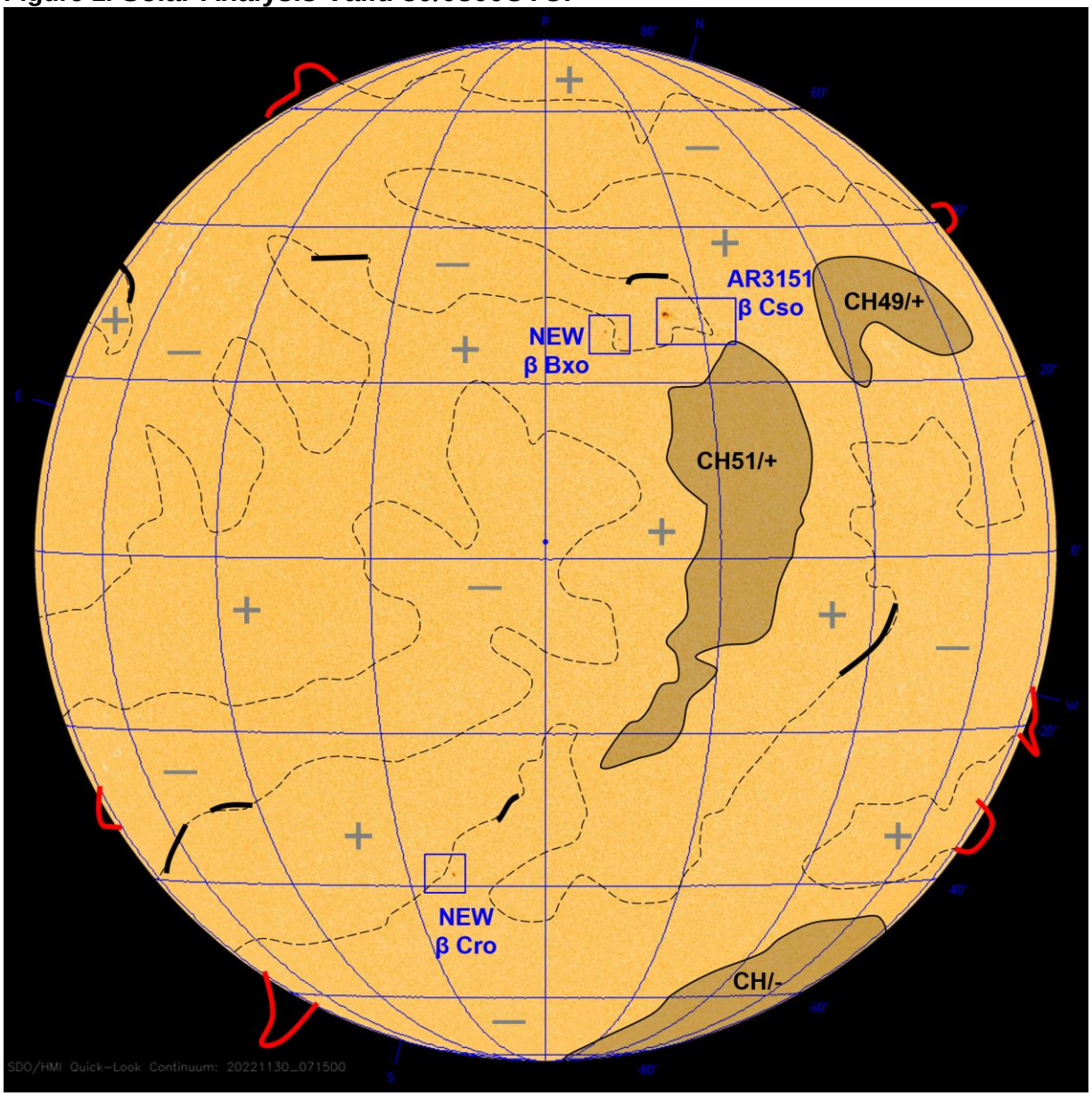
GEO, as observed by GOES16 is currently at background levels and is expected to remain at this level throughout. High energy electron flux (greater than 2 MeV), observed by GOES16, is at high levels. This is expected to continue until the arrival of CH51/+ late on day 1 or during day 2 (30th or 1st). Confidence is relatively low due to uncertainty surrounding possible geomagnetic responses during the arrival of CH51 HSS, as well as any activity due to the ongoing strong winds. However, it is likely that the High threshold (1e3 pfu) will be breached each day during the diurnal maximum.

Fluence levels are marginally below the 1e8 integrated electron fluence active threshold, yet on a continued rising trend and are expected to go above the active threshold by 20/1500UTC. The confidence of active electron fluence reduces each day until day 4 (3rd) due to the expected recompression event and geomagnetic response from coronal hole 51. High electron fluence is considered likely again on day 4 (3rd) after the HSS from coronal hole 51 has passed.

Figure 1. Solar Analysis Valid 30/0800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

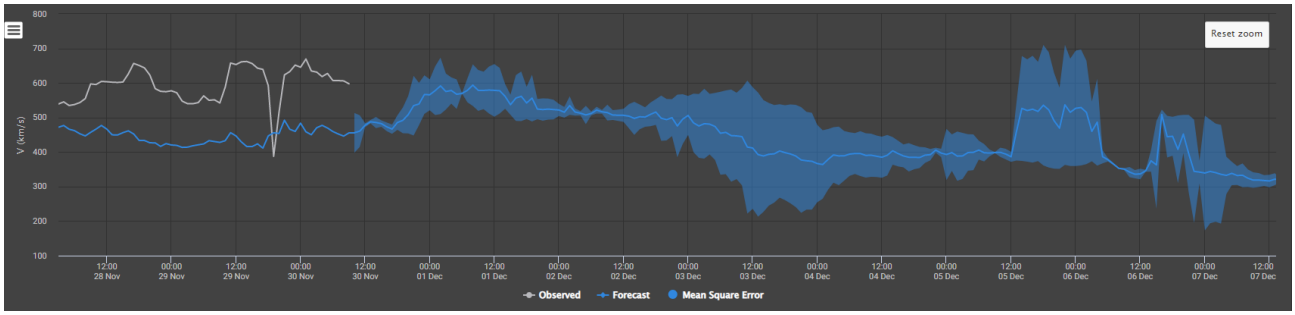
No Earth-directed CMEs are expected during the period, through several CME's are currently being computed.

Solar winds are currently strong due to the connection with coronal hole 49. The next solar wind enhancement is expected either late on day 1 (30th Nov) or early on day 2 (1st Dec) due to the arrival of the high speed stream from coronal hole 51. This is a recurring feature, with solar winds peaking at around 550-600 km/s on the previous rotation. Similar, perhaps faster (600-700 km/s) solar winds can be expected due to the apparent increase in size and darkening of this of this feature on the SDO-193 imagery.

Geomagnetic activity is expected to be Unsettled to Active with likely isolated G1/Minor storm intervals due to the onset of CH51/+ during either day 1 or day 2 (30th or 1st), with a slight chance of G2/Moderate storms. The chance for G1/Minor storming intervals then reduces into day 3 and beyond due to the waning effects of CH51/+.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	60	60	30	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC SWPM



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Radio Blackouts - X-Ray Flares:

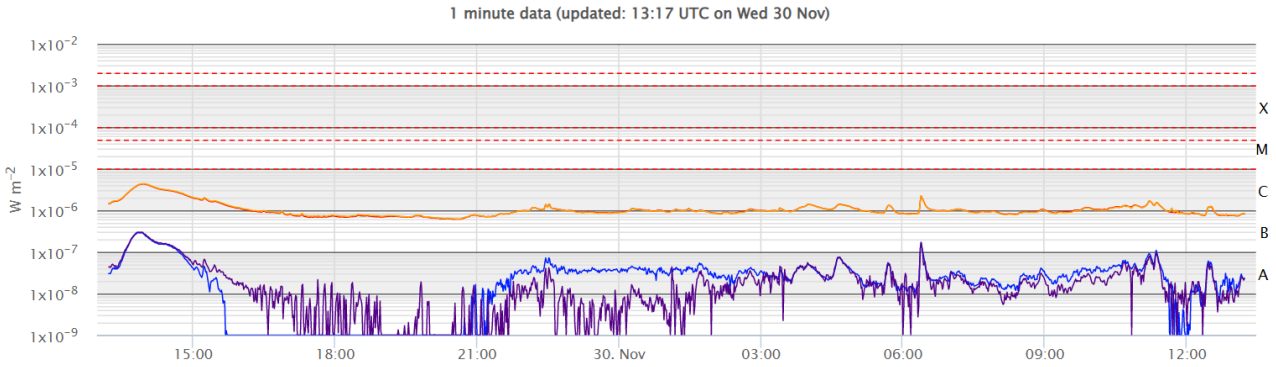
Solar activity has been Low over the past 24 hours, with several low levels C-class flares, and one long duration C4.2, which appeared from AR3151 as it rotated off the western limb. Activity is expected to be Low, with further isolated C-class flares considered likely, and just a very slight chance of isolated M-flares.

There are currently three sunspot regions on the visible disc. AR3152, in the northwestern hemisphere, and two small and simple NEW regions are also present. One follows shortly behind the aforementioned numbered region, and the other in the southeast heading toward the central meridian, all active regions are small and simple.

Far-sided seismic data suggests a couple of possible active regions returning around the east limb during the period. Probabilities are being maintained until these possible active regions emerge onto the visible disc.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	5	5	5
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: 24 hour X-ray trace



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10MeV) at GEO, as observed by GOES16 is currently at background levels and is expected to remain at this level throughout.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2 MeV), observed by GOES16, is at high levels. This has been a result of the relaxing of the Van Allen belts post charging event from coronal hole 49. A re-compression is then expected due to the arrival of coronal hole 51 late day 1 (30th) or on day 2 (1st). Confidence is relatively low due to uncertainty surrounding possible geomagnetic responses during the arrival of CH51 HSS, as well as any activity due to the ongoing strong winds. However, it is likely that the High threshold (1e3 pfu) will be breached each day during the diurnal maximum.

Fluence levels are marginally below the 1e8 integrated electron fluence active threshold, yet on a continued rising trend and are expected to go above the active threshold by 20/1500UTC. The confidence of active electron fluence reduces each day until day 4 (3rd) due to the expected recompression event and geomagnetic response from coronal hole 51. High electron fluence is considered likely again on day 4 (3rd) after the HSS from coronal hole 51 has passed.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	95	70	40	60
Very Active	≥ 2 MeV ≥ $1x10^9$	No	2	5	1	1

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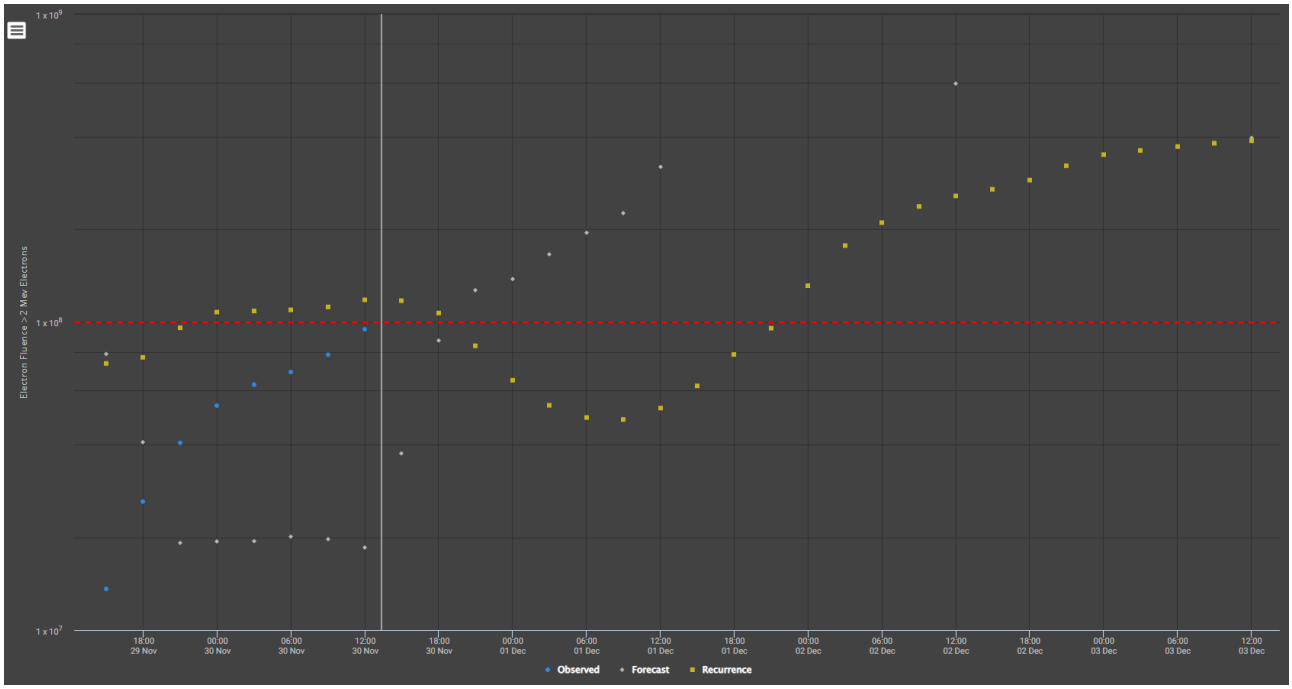
Figure 4: REFM integrated flux/fluence model, persistence and observed.



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